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Emerging patterns of change for tomorrow's cities

D.P. Henriques
Faculty of Engineering and Environment, Northumbria University, Newcastle upon Tyne, United Kingdom

ABSTRACT: Today, climate and demographic changes are becoming the greatest challenges for cities and their multicultural populations. On the other hand, there is a growing societal acceptance of information and communication technologies around the globe. And this connectivity is influencing both design thinking and research methods, while generating large quantities and a wide variety of data. In this paper, emerging patterns of change for future cities are surveyed, and international networks for urban research are highlighted. As such, criteria to analyze and compare trends, shifts and hypes in urban studies and planning are searched. Moreover, interactions between open data and green infrastructures are foreseen, in order to promote public development for future cities. Finally, a need for common mind sets and methods is claimed, namely between computing and social sciences, to engage local communities and public organizations.

1 INTRODUCTION

According to Mortensen (2015) *change*, in its most general conception, can be seen as 'difference or non-identity in the features of things,' whilst another usage may be temporal change, exemplified by 'change in the properties of a body over time.' In his perspective, the change of temperature in distinct components of a body could be measured, the change in atmospheric pressure at different places might be recorded by isobars, and/or the change of parameters of a surface/body would be represented by numerical descriptions, contour lines or distinct colors. Nevertheless, '[c]hange is so pervasive in our lives that it almost defeats description and analysis' (Mortensen 2015).

At a recent TED Talk in Vancouver BC, Al Gore (2016) recalled our attention to a series of extreme weather events increasing around the world in recent years, which show dramatic *climate change* effects on cities, regions, countries and their multicultural populations, in past and present times, and for the future: Typhoon Haiyan in Philippines and Pacific Ocean, Storm Sandy in the west coast of the United States of America, particularly in New York City, and historic floods in Chile, Brazil, Serbia, Czech Republic, Mozambique, India, China, and Australia.

Since the turn of the 21st century, and for the first time in human history, the majority of the world's population is already living in metropolises, cities, towns, and other urban settlements. While the world's population by 2015 was estimated to be around 7.3 billion, of whom 60% are living in Asia, it is projected to reach 8.5 billion by 2030, and up to 9.7 billion people by the year 2050, of whom 66% will be living in cities. And this *demographic change* is not predicted to occur evenly in the entire globe, but also in extremes: whilst half of the global population growth between now and the year 2050 is anticipated to occur in Africa, a considerable decline is expected over the same period of time for the population in Europe (UN 2015).

This global and pervasive change in densification of urban populations, in developing and developed regions of the world, will certainly increase strains on the built environment, public spaces, buildings, infrastructures, transportation, energy, water, waste and other urban systems, and probably on the natural systems of the planet Earth as well.

On the other hand, there is a global acceptance of information and communication technologies (ICT) at all levels in societies, such as internet, static and mobile computing devices and wireless networks, clouds, GPS satellites, and so forth. As such, this *connectivity* between people, things, natural and built systems, is influencing design thinking and methods, while generating previously unforeseen quantities and variety of data.

What will cities look like in the future? How are networks of researchers generating and sharing data and knowledge on urban systems, in order to address these climate and societal challenges? In this paper, emerging patterns of change for tomorrow's cities are surveyed, while pointing out international *networks for urban research* that are tackling those challenges both in the lab, in the office, classroom, and at the auditorium, on headquarters and also on campus, in the field and increasingly online.

2 MODELS, FORESIGHT AND CHANGE

Whilst urbanization is already facing these complex and unprecedented challenges, such as climate and demographic changes, it is also influencing theorists, academics, researchers and planning practitioners to understand cities as *complex systems* (Batty 2013, Jacobs 2001), through an interdisciplinary approach not only for real time sensing, visualizing, modeling, and managing processes for today's cities, but also

for medium and long term strategic thinking and planning for the cities of tomorrow (Moir et al. 2014, Tewdwr-Jones & Goddard 2014, Ward 2004, Echenique & Saint 2001). Although several issues about knowledge transferability can be raised (e.g. a city is neither a tree nor a war), this understanding of complexity and uncertainty can have a considerable impact in urban studies and planning, since it has proven results in other fields during the 20th century, such as warfare and business operations, as it will be summarized in the following paragraphs.

2.1 *From warfare to business operations*

Mostly during second world war, researchers were mobilized into military operations and governments, to develop new fields, such as atomic and nuclear energy, radar, and computers: the results have been applied and known worldwide. In the 1950s and 1960s, many of these researchers were employed by private corporations and/or public institutes, to adopt the mathematical models and analysis to business operations, namely through foresight, trend reports, *scenarios* and other innovative processes that could alter past mental conceptions and enable unthinkable futures. Thus, corporate planning in such companies like General Electric (GE) and Royal Dutch/Shell Group (Shell) developed new standards for medium and long term strategic thinking and planning, which allowed these corporations to act quickly in crisis situations (e.g. Yom Kippur War in the Middle East and the following oil embargo), and to move into leading positions in the global markets, until today. Moreover, *systems thinking* was being developed by researchers, and applied to model interconnections and explore limits between key variables, such as population, natural resources, pollution, food and industrial production (Benn et al. 2014, Kosow & Gaßner 2008, Ringland & Young 2006, Wilson 1992).

2.2 *Complexity, computers and data*

Particularly since the 1970s, the initial acceptance of computers also started to change urban studies and planning, but they were available only to a limited number of theorists, researchers and practitioners. For example, Tobler (1970) and Batty (1976) developed models to analyze, visualize and understand urban complexity, through computing methods and collaborations with researchers from other fields, to enable innovative advances in urban research.

However, in the last decade static and mobile computing devices and wireless networks have been embedded in all aspects of our daily life, and societies in almost every location of the globe seem to accept this connectivity. These (new) digital possibilities are influencing both design thinking and research methods, and opening paths for novel sub-disciplines, for instance digital fabrication, generative and algorithmic design (Hanna 2013, Oxman & Oxman 2013, see also Hauschild & Karzel 2011).

At the moment, the possibilities of data to inform, model, manage and foresee complex urban systems and planning processes might be highly promising (if not overwhelming): more than 90% of all the data in the world has been generated since 2011, and this seems to be increasing non-linearly with more data being generated and released by people and/or things, groups and periods of time, which can be combined into larger groups and/or longer periods of time, shaping up what is presently named big data, and widening the range of advantages for research (Dragland 2013).

As such, between the utopian and dystopian urban visions imagined over the past centuries, and the best practice examples of urban planning around the world, there is the momentum to share *urban data* among public sector organizations, universities, transnational ICT corporations and local community groups involved and interested in urban research through international networks.

3 URBAN PATTERNS OF CHANGE

3.1 *Green, smart, refugee and collective*

In the past, several urban visions were proposed by historians, academic and practicing planners, novel writers and film directors, geographers, environmentalists and preservationists, local and neighborhood communities, public policy makers, and/or other stakeholders interested in urban processes, and some of these visions were planned, built and can be experienced today as best practice examples of resilient urbanism. In this section, emergent patterns of change in urban studies and planning will be surveyed: (a) the garden cities movement and its legacy for a green future; (b) the global smart cities trend, where governments and ICT corporations join forces; (c) the sudden increase of refugee camps, tent cities and shanty towns due to extreme weather events and man-made disasters; (d) the engagement policies and actions involving local communities; and (e) the open data initiatives.

3.2 *Garden, eco and green cities*

Initially proposed in *To-morrow: A Peaceful Path to Real Reform*, Howard's (1898) garden cities vision, i.e. a network of urban settlements combining city and country characteristics in order to manage social and economic change, has been claimed to be one of the most enduring and transferable of those visions, influencing urban planning in Europe and also worldwide, for more than one century (Ward 2016, Dunn et al. 2014, Hall & Ward 1998).

While addressing solutions to housing shortage and pollution issues in growing mega cities, such as London in the end of the 19th century (and in many other locations still today), Howard developed an urban vision that combined both natural and built environment. Furthermore, the garden cities vision promotes a sense of community and considers limits of growth (e.g. the green belt strategy), while structuring a hierarchy of planning principles that allowed it to be reconfigurable and adapted in very different geographical, economic, cultural and even social contexts, and has ultimately also generated data and knowledge from scholars from distinct disciplines (Stern et al. 2013, Ward 1992, Hall 1988). And, to implement his urban vision, Howard also started the organization now known as the Town and Country Planning Association (TCPA), which laid ground for other similar groups in different countries, and for an international network that organized visits to the best practice case examples (e.g. Letchworth, Welwyn garden cities), meetings and conferences, even in some conturbated periods of world wars. Moreover, the garden cities movement (and the TCPA) helped to build the conceptual and methodological structure of a national planning policy in the United Kingdom, more concerned with environmental issues, and global policies for green cities which are still valid today, thus engaging through top-down and bottom up approaches, and promoting social and environmental values (Parsons & Schuyler 2002, Fishman 1977, see also Hein 2014, Jacobs 1961).

Considering the wide geographical application, the considerable timescale, the success of both top-down and bottom-up engagement, the promotion and adoption of social and environmental values, and how it laid ground for data and knowledge access through international networks and scholarly work, the garden cities movement can be considered the most meaningful (modern and) contemporary trend in urban studies and planning.

In fact, garden, eco and green labeled cities are spreading worldwide, though sometimes is not clear what ties together all these cities. Nevertheless, strong research in urban studies and planning with environmental motivations is still needed (Beatley 2012, Cohen 2011), to address these issues not only in higher education, but at all levels of society, for future generations and maybe even for the survival of humankind.

3.3 *Smart cities and ICT corporations*

ICT and Internet of Things (IoT) are currently being applied in experimental pilot initiatives across the globe to envision, monitor, and also manage urban systems (e.g. water, food, energy, green, waste, transport and communication), in order to generate and promote economic prosperity, social well-being, efficiency and sustainability.

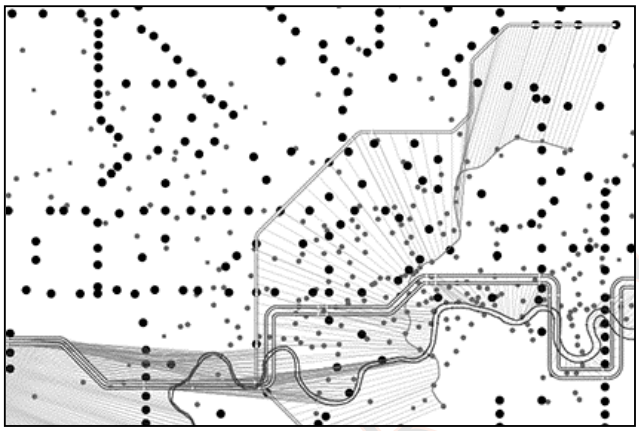

Figure 1. London's metrography, data visualization/mapping processes, 2012. Authors: Benedikt Groß & Bertrand Clerc. (Courtesy of the authors). Available at: <http://benedikt-gross.de/log/2012/02/metrography-london-tube-map-to-large-scale-collective-mental-map/> [accessed 2016-2-21].

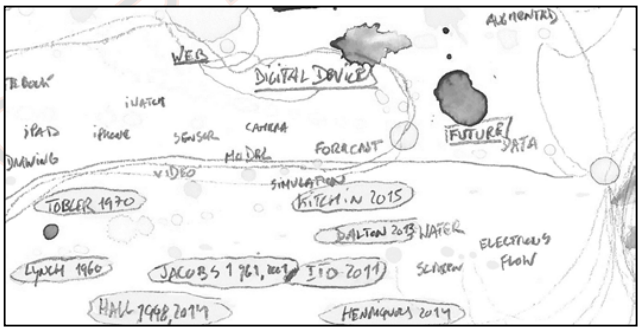

Figure 2. Timeline sketch, mapping technological processes and key researchers in urban studies and planning.

Figure 3. World map of garden cities.

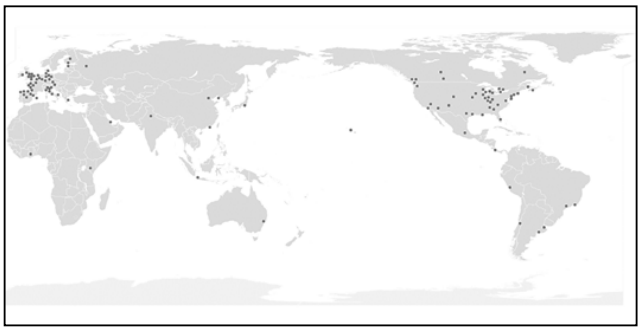

Figure 4. World map of open data initiatives, mostly distributed in Western Europe and North America regions.

On the one hand, recent examples from *tabula rasula* experiments with embedded ICT integrated in the earlier stages of the urban planning process (e.g. Songdo in South Korea, Masdar in the United Arab Emirates), developed by transnational corporations, seem to show evidence that successful cities thrive through a complex interaction of urban systems, whatever their classification relates to garden, eco, green, smart, or (gentrified) historic, with their local and neighborhood communities

On the other hand, and particularly through public developments in Europe, some degree of success is shown in overlapping new systems of ICT and IoT, which are adjusted to existing cities, alongside green infrastructure, tangible and intangible heritage, and so forth (Manville et al. 2014). And this seems to confirm that an interdisciplinary approach to cities is needed. While it could be argued that the association of both trends, i.e. urbanization and digitization, has indeed the potential to inform urban studies and planning, modeling, foresight, and also management processes in cities, there is still the need of evidence for civic and other cultural utilizations (Batty 2016, Kitchin 2016, 2015, Henriques 2014).

Particularly in smart cities, these transnational ICT corporations have been showing a deep interest in the generation of urban visions that seem to promote major changes in most urban lives, following such visionaries like Jane Jacobs or Le Corbusier (Greenfield 2016). This recent global smart trend (or is it only a hype?), promoted by corporations such as IBM, Cisco and Google, might raise ethical issues and other implications for the future of humanistic cities, since it implies opportunistic sensing and monitoring of its citizens through algorithms, sensors, cameras, crowdsourcing and other information extraction networks essentially from a top-down perspective. Nevertheless, more can be made through partnerships between some of these corporations, universities, local institutions and communities, to enable informal data collection and mapping efforts of bottom-up approaches, in order to augment our understanding of cities as complex systems.

3.4 *Refugee camps, tent cities and shanty towns*

Probably in every period of history, urbanization and temporary settlements such as refugee camps, tent cities, shanty towns and slums, have been associated (see also Lefebvre 2003). For example, between the 19th and the 20th century, slums were common in London (Yelling 2007), and Howard's invention of the garden cities vision was a response to those challenges. Nonetheless, refugee camps, tent cities and shanty towns continue to spread nowadays (Davis 2006, Neuwirth 2005), in particular caused by extreme weather events and other natural disasters, and also man-made disasters, for instance war, famine, social and economic inequality and/or pollution.

Although emergent research is being conducted in these areas (WHO 2016, Iosifova 2015, and also in forthcoming exhibitions at the Architecture Biennale in Venice and in the MoMA in New York), still much has to be done: their geographical location, timescale, the urgent necessity of both top-down and bottom-up engagement, and also the major social and environmental issues that these temporary cities are raising, make these temporary settlements one of the most underestimated trends in urban studies and planning for international networks. Available data and knowledge access could be a positive solution to promote research engagement, and perhaps even a meaningful shift for all humankind.

3.5 *Community engagement and open data cities*

Jacobs defended that '[n]o other expertise can substitute for locality knowledge in planning', thus arguing that '[t]he invention required is not a device for coordination at the generalized top, but rather an invention to make coordination possible where the need is most acute - in specific and unique localities' (1961), while laying the bases of a strong bottom-up reaction in the 1960s and following decades against the top-down approaches in urban studies.

Open data has been seen as a bottom-up approach to involve communities in the digitization of 'smart' urban systems and utilization of data sets, previously only available to researchers and institutions, in closed silos. Furthermore, the usability of transferable lessons between the smart and garden urban visions could allow a shift, in order to support new bottom-up perspectives on civic and social international networks to address climate and demographic change (Henriques 2016). This could promote community engagement in future cities, through interactions between environmental open data and green infrastructures, integrated in resilient urban systems to face extreme weather events. At the present stage, most of open data initiatives (either promoted by local institutions or by governments at a national level) are located in Europe and North America.

Moreover, hackathons and other collective events have been particularly successful in the last years, and these could be considered either a hype or a shift, within community engagement. These events can test, develop and show new methods and methodologies to conduct interdisciplinary research strategies and to involve public organizations, universities, corporations, and local communities.

While it seems that digital structures also follow geographical laws (Hecht & Moxley 2009), urban research concerning human factors (Walf et al. 2015, Henriques 2013, Zimring & Dalton 2003) is needed. Perhaps, common(s) language(s) such as maths, sounds, images, visual and textual programming might represent possible links within international and multicultural networks.

4 CONCLUSION

In this paper, initial criteria to analyze and compare trends, shifts and hypes in urban research were searched: (a) geographical location; (b) timescale; (c) top-down and bottom-up engagement; (d) social and/or environmental values; and most importantly (e) data and knowledge access.

As stated in the EAAE/ARCC 2016 call, '[a]lthough challenges are global, solutions need to be implemented locally.' And international networks for urban research, including universities, can thus contribute to imagine, discuss, develop and promote alternative futures for a changing society. For example, the principles that supported the global garden cities movement can lay ground for open data initiatives: data is the new soil. Thus, possible interactions between environmental open data and green infrastructures are foreseen, for public development in tomorrow's cities. Nonetheless, future research is still needed, in experimental urban data visualization alongside user experience studies, within urban planning processes.

Although interdisciplinary research strategies are essential between corporations, universities and local businesses to address these urban challenges, such as climate and demographic changes, it was claimed a need for common mind sets and methods, particularly connecting both computing and social sciences, to engage with local and neighborhood communities, and public organizations.

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6 REFERENCES

Batty, Michael 2016. How disruptive is the smart cities movement? *Environment and Planning B: Planning and Design* 43 (3): 441-443.

Batty, Michael 2013. *A new science of cities*. Cambridge MA: The MIT Press.

Batty, Michael 1976. *Urban modelling: algorithms calibrations, predictions*. Cambridge: Cambridge University Press.

Beatley, Timothy (ed) 2012. *Green cities of Europe: global lessons on green urbanism*. Washington DC: Island Press.

Benn, Suzanne, Dunphy, Dexter & Griffiths, Andrew 2014. *Organizational change for corporate sustainability (3rd edition)*. Abingdon, New York: Routledge.

Boulos, Maged & Al-Shorbaji, Najeeb 2014. On the internet of things, smart cities and the WHO healthy cities. *International Journal of Health Geographics* 13 (10): editorial.

Figure 5. Excerpt of 'Dark clouds of factory smoke obscure Clark Av.', 1973. Author: F.J.Aleksandrowicz (Public domain).

Figure 6. Outskirts of Tacloban on Leyte island in Philippines, after Typhoon Haiyan, on November 8, 2013. Author: Trócaire/Caritas (Wikimedia Commons via Flickr CC-BY-2.0).

Figure 7. Za'atri camp in Jordan for Syrian refugees, on July 18, 2013. Author: U.S. Department of State (Public domain).

Figure 8. Attendees at the Spring 2013 hackNY Hackathon. Author: M.Czarnecka (Flickr CC-BY-SA-2.0).

Card, Stuart K., Mackinlay, Jock D. & Shneiderman, Ben 1999. *Readings in information visualization: using vision to think*. San Diego CA: Academic Press.
Cohen, Nevin (ed) 2011. *Green cities: an A-to-Z guide*. Los Angeles CA: Sage.
Davis, Mike 2006. *Planet of slums*. London, New York: Verso.
Dragland, Ase 2013. Big data - for better or worse. *SINTEF website*. Available at: <https://www.sintef.no/en/news/big-data--for-better-or-worse/> [accessed 2016-2-21].
Dunn, Nick, Cureton, Paul & Pollastri, Serena 2014. *A visual history of the future*. London: Foresight, Government Office for Science.
Echenique, Marcial & Saint, Andrew (eds) 2001. *Cities for the new millennium*. London, New York NY: Spon Press/Taylor & Francis.
Fishman, Robert 1977. *Urban utopias in the twentieth century: Ebenezer Howard, Frank Lloyd Wright, Le Corbusier*. New York NY: Basic Books.
Greenfield, Adam 2013. *Against the smart city*. New York NY: Do Projects.
Gore, 'Al' 2016. Presentation at TED 2016, Vancouver BC.
Hall, Peter 2014. *Good cities, better lives: how Europe discovered the lost art of urbanism*. Abingdon, New York NY: Routledge.
Hall, Peter 1988. *Cities of tomorrow: an intellectual history of urban planning and design in the twentieth century*. Oxford: Blackwell Publishing.
Hall, Peter & Ward, Colin 1998. *Sociable cities: the legacy of Ebenezer Howard*. Chichester: John Wiley & Sons.
Hanna, Sean 2013. Levels of uncertainty in design. Previously in *sg articles Smartgeometry website* [accessed 2016-2-21].
Hauschild, Moritz & Karzel, Rudiger 2011. *Digital processes: planning, designing, production*. Basel: Birkhauser.
Hecht, Brent & Moxley, Emily 2009. Terabytes of Tobler: evaluating the first law in a massive, domain-neutral representation of world knowledge. In K. Stewart Hornsby et al. (eds) *Spatial information theory*: 88-105. Berlin, Heidelberg: Springer.
Hein, Carole 2014. The exchange of planning ideas from Europe to the USA after the second world war: introductory thoughts and a call for further research. *Planning Perspectives* 29 (2): 143-151.
Henriques, Diogo Pereira 2016. Learning from garden cities: international networks to address climate change. In Carola Hein (ed) *International Planning History Society Proceedings, 17th IPHS Conference, History-Urbanism-Resilience, TU Delft 17-21 July 2016, V 03*: 043. Delft: TU Delft Open.
Henriques, Diogo Pereira 2014. ... of things and people @ smart cities. In Olivia Bina et al. (eds), *Urban futures-squaring circles: Europe, China and the World in 2050. Conference proceedings*: 49. Lisbon, Rome, Hong Kong: Institute of Social Sciences - University of Lisbon, Institute of Studies for the Integration of Systems, The Chinese University of Hong Kong.
Henriques, Diogo Pereira 2013. Space time information on display: smart devices and spatial cognition. In Helena Bartolo et al. (eds), *Green design, materials and manufacturing processes*: 519-532. London: CRC Press/Taylor & Francis.
Howard, Ebenezer 1898. *To-morrow: a peaceful path to real reform*. London: Swan Sonnenschein & Co.
Iossifova, Deljana 2015. Borderland urbanism: seeing between enclaves. *Urban Geography* 36 (1): 90-108.
Jacobs, Jane 2001. *The nature of economies*. New York NY: Vintage Books.
Jacobs, Jane 1961. *The death and life of great American cities*. New York NY: Random House.
Kitchin, Rob 2016. *Getting smarter about smart cities: improving data privacy and data security*. Dublin: Data Protection Unit, Department of the Taoiseach on behalf of the Government Data Forum.
Kitchin, Rob 2014. The 'real-time' city? Big data and smart urbanism. *GeoJournal* 79 (1): 1-14.
Kosow, Hannah & Gaßner, Robert 2008. Methods of future and scenario analysis: overview, assessment, and selection criteria. Studies 39. Bonn: Institut fur Entwicklungspolitik.
Lefebvre, Henri 2003. *The urban revolution*. Minneapolis MN, London: University of Minnesota Press.
Lehmann, Steffen 2010. The principles of green urbanism: transforming the city for sustainability. London: Earthscan.
Manville, Catriona, Cochrane, Gavin, Cave, Jonathan, Millard, Jeremy, Pederson, Jimmy, Thaarup, Rasmus, Liebe, Andrea, Wissner, Matthias, Massink, Roel & Kotterink, Bas 2014. *Mapping smart cities in the EU*. Brussels: European Parliament's Committee on Industry, Research and Energy.
Moir, Emily, Moonen, Tim & Clark, Greg 2014. *What are future cities? Origins, meanings and uses*. s.l.: compiled by The Business of Cities for the Foresight Future of Cities Project and the Future Cities Catapult.
Mortensen, Chris 2015. Change and inconsistency, In Edward N. Zalta (ed.) *The Stanford encyclopedia of philosophy*, <http://plato.stanford.edu/archives/fall2015/entries/change/> [accessed 2016-2-21].
Neuwirth, Robert 2005. Shadow cities: a billion squatters. A new urban world. New York NY, London: Routledge.
Oxman, Rivka & Oxman, Robert 2014 (eds). *Theories of the digital in architecture*. New York NY: Routledge.
Parsons, Kermit & Schuyler, David (eds) 2002. *From garden city to green city: the legacy of Ebenezer Howard*. Baltimore MD, London: Johns Hopkins University Press.
Ringland, Gill & Young, Laurie 2006. *Scenarios in marketing*. Chichester: John Wiley & Sons.
Stern, Robert A.M., Fishman, David & Tilove, Jacob 2013. *Paradise planned: the garden suburb and the modern city*. New York NY: The Monacelli Press.
Tewdwr-Jones, Mark & Goddard, John 2014. A future for cities? Building new methodologies and systems for urban foresight. *Town Planning Review*, 85 (6): 773-794.
Tobler, Waldo 1970. A computer movie simulating urban growth in the Detroit region. *Economic Geography* 46, Supplement: 234-240.
United Nations, Department of Economic and Social Affairs, Population Division 2015. *World population prospects: the 2015 revision, Data booklet*. *ST/ESA/SER.A/377*.
Walf, Alicia, Koonce, Carolyn & Frye, Cheryl 2015. Progestogens' effects and mechanisms for object recognition memory across the lifespan. *Behavioural Brain Research* 294: 50-61.
Ward, Stephen 2016. *The peaceful path: building garden cities and new towns*. Hatfield: University of Hertfordshire Press.
Ward, Stephen 2004. *Planning and urban change (2nd edition)*. London: Sage Publications.
Ward, Stephen (ed) 1992. *The garden city: past, present and future*. London, New York NY: Spon Press/Taylor & Francis.
Wilson, David 1992. *A strategy of change: concepts and controversies in the management of change*. London: Routledge.
WHO 2016. *Global urban ambient air pollution database (update)*. Available at <http://www.who.int/phe/health_ topics/outdoorair/databases/cities/en/> [accessed 2016-5-12].
Yelling, James 2007. Slums and slum clearance in Victorian London. London, New York NY: Routledge.
Zimring, Craig & Dalton, Ruth Conroy 2003. Linking objective measures of space to cognition and action. *Environment and Behavior*, 35 (1): 3-16.